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RESEARCH

Japanese internally headed relatives: A hybrid analysis with Kuroda functions

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This paper argues that the analysis of Japanese internally headed relatives must steer a course between the Scylla and Charybdis of reduction to externally headed relatives and reduction to discourse anaphora. The analysis given here is based on that of Grosu & Landman (2012), but the present paper reconsiders some of the central data in Grosu & Landman (2012) in the light of the diagnostic tests given in Grosu & Hoshi (2016), and argues for a simplification of the basic analysis, which actually strengthens the theory considerably. The paper then extends the analysis given with an analytic tool – a Lombardian presupposition mechanism for Kuroda functions – which allows the implementation of the Kuroda relevancy condition (Kuroda 1976–77). It is further shown how the improved analysis can provide a semantics for so-called *change relatives*, which were mentioned but not analyzed in Hoshi (1995) and Kim (2007). An appendix recapitulates and refines the discussion of scope phenomena in internally headed relatives from Grosu & Landman (2012).

Keywords: relative clauses; internally headed; Kuroda relevancy; syntax-semantics of Japanese

1 The Scylla and Charybdis of Japanese internally headed relatives

1.1 The subsumption analysis and its problems

The bracketed expression in (1) is an example of an internally headed relative clause.

(1) ✓Taro-wa [Yoko-ga reezooko-ni *kukkii-o* *sukunakutomo mit-tsu* irete-oita-**no**]-o
Taro-TOP [Yoko-NOM refrigerator-LOC *cookie*-ACC *at least* 3-CLF put-AUX-**no**]-ACC
paatii-ni motteitta.
party-to brought
Taro brought to the party *[the sum of all the cookies such that…]*
Yoko put *at least three cookies* in the refrigerator.
'Yoko put at least three cookies in the refrigerator. Taro brought them to the party.'

Example (1) shows the following properties of internally headed relatives. The relative – bracketed in (1) – is a clausal structure, marked by the element *no* (the literature does not have a univocal opinion as to the status of this element). No gap or resumptive pronoun is visible in the clause in question, it looks like a full clause. However, the clause occurs in argument position (it is marked accusative in (1)), and has the interpretation of a noun phrase. This is the rationale for calling it a relative clause. In fact, the clause has the interpretation of a *definite* noun phrase ('*the* cookies that Yoko put in the fridge'). It derives its noun phrase interpretation from a constituent inside the relative, *the internal head* (*kukkii sukunakutomo mit-tsu-*'at least three cookies'). The internal head is not

marked grammatically in any special way. The bracketed expression *[the sum of all the cookies such that…]* I will call the *interpretation head*.

Ito (1986) and Watanabe (1992) (among others) proposed unified analyses of internally headed and externally headed relatives, assuming (in essence) the same mechanism for both, and taking the differences to lie in whether the head of the relative moves in the syntax or at some other level, and where it ends up (and at which level). Since the basic mechanism assumed is the standard mechanism for externally headed relatives, this approach tries to subsume internally headed relatives under the more familiar externally headed case. Hoshi (1995) argued extensively against this approach. He pointed out that the standard interpretation of the mechanism for externally headed relatives would predict that (1) has the same meaning as the comparable externally headed relative:

Taro brought to the party at least three cookies that Yoko put in the fridge.

But (1) doesn't mean that, (1) expresses that Taro brought *all* of the cookies that Yoko put in the fridge to the party (see also Shimoyama 1999; 2001).[1]

Kuroda (1976–77), Hoshi (1995) and Shimoyama (1999) discuss various other semantic differences between internally and externally headed relatives. I will here discuss three types of differences that are particularly relevant for the present paper (all these cases have been discussed in the literature, and the examples are based on similar examples in Hoshi 1995; Kim 2007; Grosu 2010; Grosu & Landman 2012. Further differences are discussed in Grosu 2010; Grosu & Landman 2012; Grosu & Hoshi 2016).

In the first place, internally headed relatives, but not externally headed relatives, must satisfy the Kuroda relevancy condition (Kuroda 1976–1977; 1992; 1999). This means that you cannot felicitously choose as the internal head an object that is not presented by the relative as sufficiently enough 'on the scene' of the main clause.

Look at the contrast between (2a) and (2b):[2]

(2) a. #[Daidokoro-no mado-kara siroi neko-ga haitte-ki-ta]-**no**]-ga
kitchen-GEN window-from white cat- NOM came-in-PAST-**no**]-NOM
kesa mata yattekita.
this morning again came
[*[The cat such that…]* a white cat came in from the window]
came back this morning.
'A white cat came in from the kitchen window; she came back this morning.'

b. ✓[Daidokoro-no mado-kara siroi neko-ga haitte-ki-ta]-**no**]-ga
kitchen-GEN window-from white cat- NOM came-in-PAST-**no**]-NOM
akana-o totte nigeta.
fish-ACC steal ran-away
[*[The cat such that…]* a white cat came in from the kitchen window]
stole a fish and ran away.
'A white cat came in from the kitchen window; she stole a fish and ran away.'

In (2a), a white cat is introduced as a cat which was involved in some event: she came in through the window. In the matrix a second event is specified of this cat: she came in

[1] While in this formulation of the argument, the head is taken to be *kukkii sukunakutomo mit-tsu-*'at least three cookies', the argument holds as well if the head is taken to be *kukkii-*'cookies'. The point is that the externally headed relative allows an indefinite restrictive interpretation that the internally headed relative doesn't have; it only allows the interpretation: 'all of the cookies that Yoko put in the fridge.' Thanks to Chris Tancredi for discussing this point.

[2] The examples are variants of examples from Shimoyama (2001). The judgements seem to be widely, but not universally, shared. See Grosu & Landman (2012) and Grosu & Hoshi (2016) for discussion of the variation in judgements, and see Grosu & Hoshi (2016) for discussion of possible sources for this variation.

through the window again today. These are two event specifications that we do not naturally think of as one scene. In Kuroda's terms, the event described in the embedded clause does not put the cat enough on the scene of the event described by the matrix to allow *siroi neko*-'white cat' to be chosen felicitously as the internal head.

On the other hand, (2b) can naturally be understood as a scene that starts with the event of the relative, the cat coming in through the window (no doubt attracted by the smell of fish), while the matrix *continues that scene* with the event of the cat stealing the fish. The cat, hence, is directly on the scene of the matrix event in (2b) and *siroi neko*-'white cat' can serve as the internal head in (2b).

Japanese externally headed relatives, like externally headed relatives in other languages, show no such constraint. While this difference is not a fatal problem for the analysis that subsumes internally headed relatives under externally headed ones, it still is rather surprising and unexpected on that analysis.[3]

A second difference between internally and externally headed relatives – and one that is more problematic for the subsumption analysis – is the fact that internally and externally headed relatives differ in what they allow as the interpretation head of the relative. In internally headed relatives the interpretation head can be semantically *derived* from the interpretation of the internal head in a way that is impossible in externally headed relatives. Look at (3a) and (3b):

(3) a ✓John-wa [Mary-ga gozentyuu-ni *ringo-o* sibottekureta-**no**]-o
John-TOP [Mary-NOM morning-in *apple*-ACC squeezed-**no**]-ACC
gogo-ni hitoikide nomihosita.
afternoon-in in-a-gulp drank-up
John drank in the afternoon in a gulp *[the juice such that …]*
Mary squeezed apples in the morning.

b. #John-wa [[Mary-ga gozentyuu-ni sibottekureta] ringo]-o
John-TOP [[Mary-NOM morning-in squeezed] apple]-ACC
gogo-ni hitoikide nomihosita.
afternoon-in in-a-gulp drank-up
'John drank in the afternoon in a gulp *the apples that* Mary squeezed in the morning.'

(3a) is an internally headed relative with internal head *ringo*-'apple'. And the example is felicitous. The interpretation head is not *apples*, but *[the juice such that]*, i.e. *apple juice*. The corresponding externally headed relative with external head *ringo*-'apples' is infelicitous, as it is in English in corresponding examples (since you cannot drink apples).

A third difference concerns examples with 'accumulation' readings. Look at (4a-c):

(4) a. Wasaburo-wa [dono gakusei-mo *peepaa-o* *3-bo* dasita-**no**]-o
Wasaburo-TOP [every student *term-paper*-ACC 3-CLF turned-in-**no**]-ACC
itiniti-de yonda.
one-day-in read
Wasaburo read in one day *[the papers such that…]*
every student turned in *three term papers*.
'Every student turned in three papers. Wasaburo read all the papers
that all the students turned in in one day.'

[3] Some further differences between internally and externally headed relatives that derive from the Kuroda relevancy condition, in particular differences concerning whether the examples in question presuppose or implicate an exactly reading, are discussed in Grosu & Hoshi (2016).

b. Wasaburo-wa [[dono gakusei-mo dasita] 3-bon-no peepaa]-o
Wasaburo-TOP [[every student turned-in] 3-CLF-GEN paper]-ACC
itiniti-de yonda.
one-day-in read

c. Wasaburo-wa [[dono gakusei-mo dasita] peepaa]-o 3-bon
Wasaburo-TOP every student turned-in] paper-]-ACC 3-CLF
itiniti-de yonda.
one-day-in read
'Wasaburo read in one day the three papers that every student turned in.'

As Shimoyama (1999) pointed out, (4a) has an accumulation reading, where if there were twenty students, Wasaburo read in one day sixty papers. The externally headed relatives in (4b-c) do not allow a similar accumulation reading; the only relevant reading that (4b-c) allow is the pragmatically odd reading where every student handed in *the same* three papers.

In this, Japanese externally headed relatives pattern with English relatives: if there are 24 cities, (5a) does not have a reading which describes the gathering of the 120 delegates from the 24 cities, and nor does the Japanese (5b):

(5) a. The five delegates that every city elected gathered in Parliament Hall for the opening ceremony.

b. [[dono tosi-mo eran-da] go-nin-no daigiin]-ga kokkai-gizidoo-ni atumatta.
every city elected 5-CLF-GEN delegate-NOM parliament-hall-in gathered

These data show that an analysis which reduces the differences between internally and externally headed relatives *just* to the question of *where* in the syntactic chain the head of the relative is spelled out is inadequate: there are semantic differences that need to be accounted for.[4]

1.2 The discourse anaphora analysis and its problems

Hoshi (1995) and Shimoyama (1999) propose a radically different analysis for internally headed relatives. They assume that the name 'internally headed relative' is really a misnomer. These are not relative clauses at all, but they are what they look like: full clauses with a propositional meaning. They derive their nominal interpretation as a definite noun phrase from the assumption that there is an implicit discourse anaphor in the DP position in the matrix. While Hoshi and Shimoyama give slightly different analyses, they both assume that the interpretation of the discourse anaphor is as a definite whose predicative content is constructed with help of the embedded clause. Hence, the embedded clause functions as a discourse background for an implicit discourse anaphor in the matrix.

Grosu (2010) and Grosu & Landman (2012) point out several differences between internally headed relatives and standard discourse anaphora constructions.

In the first place, since the embedded clause contains the internal head, both Hoshi and Shimoyama must assume that the discourse anaphor derives its content *obligatorily*, i.e. semantically, from the embedded clause. Discourse anaphora typically do not have such

[4] Chris Tancredi points out that an accumulation reading *is* possible for externally headed relatives where the numerical is inside the relative and *peepaa*-'paper' is the external head, as in (i):

(i) Wasaburo-wa [[dono gakusei-mo 3-bon dasi-ta] peepaa]-o itiniti-de yonda.
Wasaburo-TOP every student 3-CLF turned-in] paper-]-ACC one-day-in read

I will come back to this case in Section 6.2.

semantic restrictions on where they need to look for their interpretation. Not in English, and not in Japanese either. (See Grosu & Landman 2012 for discussion.)

Secondly, internally headed relatives are infelicitous when the internal head is interpreted in the scope of negation as in (6a):

(6) a. #[*Hitorino insei-mo* doyoobi-no party-ni *ika-nakat-ta*-**no**]-ga
[*any grad-student* Saturday-GEN party-to *go-Neg-Past*-**no**]-NOM
jitsuwa uchi-de peepaa -o kaite ita.
in-fact home-at paper-ACC writing was
[the students such that…] ***no*** *graduate student(s)* came to the party on Saturday were in fact writing term papers at home.

In contrast, (6b) with a discourse anaphor is felicitous:[5]

(6) b. ✓*Hitorino insei-mo* doyoobi-no party-ni *ikanakatta*.
any grad-student Saturday-GEN party-to go-**NEG**-PAST
Karera-wa jitsuwa uchi-de peepaa-o kaite ita.
they-TOP in-fact home-at paper-ACC writing was
No graduate student(s) came to the party on Saturday. They (i.e., the students) were in fact writing term papers at home.

Thus, discourse anaphora allow accommodation of *students* in (6b). Internally headed relatives do not allow such accommodation.

Thirdly – and most problematically for the discourse anaphor analysis – internally headed relatives show island effects. When the internal head is in a syntactic island, the internally headed relative is infelicitous. This was first pointed out by Watanabe (1992; 2003). Watanabe noted the contrast between (7a) and (7b):

(7) a. ✓Mary-ga [John-ga [zibun-no gakusei-ga *juuyouna kasetsu-o*
Mary-NOM [John-NOM self-GEN student-NOM *important hypothesis*-ACC
teian-shi-ta to] jimanshite-ita-**no**]-no kekkan-o shiteki-shi-ta.
propose-do-PAST-to] boasted-had- **no**]-GEN defect-ACC point-out-do-PAST
Mary pointed out a defect in: *[the important hypothesis such that …]*
John had boasted that his student proposed *an important hypothesis*.

b. #Mary-ga [John-ga [*atarashii kasetu-o* teianshita gakusei-o]
Mary-NOM [John-NOM [*new hypothesis*-ACC *proposed student*-ACC]
homete-ita-**no**]-no kekkan-o shitekishita.
praise-had-**no**]-GEN defect-ACC pointed-out
#Mary pointed out a defect in: *[the new hypothesis such that …]*
John had praised [the student who proposed *a new hypothesis*].

Grosu and Landman (2012) argue that, whereas there is systematic variation among speakers concerning the acceptability of the internally headed relative (7a) – judgements range between totally acceptable, somewhat odd, and totally unacceptable – there is no such variability with respect to (7b): the internal head is inside a complex noun phrase and (7b) is judged infelicitous by everybody.

[5] Note that the contrast is not to do with the fact that *Hitorino insei-mo*-'any grad student' is a negative polarity item: replacing the polarity item by *subete-no in sei—wa*-'all (the) grad students' produces the same difference in felicity between the internally headed relative and the discourse anaphor structure (thanks to Chris Tancredi for bringing up this point and this example).

Other cases of island sensitivity, in particular adjunct islands, are discussed in Grosu and Hoshi (2016), which also contains extensive discussion eliminating challenges to this and similar data, showing beyond doubt that indeed internally headed relatives are sensitive to island constraints.

In contrast with this, island sensitivity is unheard of for discourse anaphora. (8a) and (8b), which correspond to (7b) but have a discourse anaphor, are completely felicitous:

(8) a. ✓John-wa *hitsuji-o* *san-tou* katteiru. [*Sorera-ni* esa-o yaru
John-TOP *sheep*-ACC 3-CLF keep [they-DAT food-ACC give
meshitsukai-wa] kyoo-wa yasumi-da.
servant-TOP] today-TOP holiday-COP
John has *three sheep*. [The servant [who feeds *them*]] is on holiday today.

b. ✓[[e] Hitsuji-o san-tou katteiru] nouhu]-wa kyoo-wa yasumi-da.
sheep-ACC 3-CLF keep] farmer]-TOP today-TOP holiday-COP
Sorede John-wa sorera-ni esa-o yaru tumori-da.
So John-TOP them-DAT food-ACC feed intension-COP
[The farmer [who owns *three sheep*]] is on holiday. So John will feed *them*.

2 A hybrid analysis for internally headed relatives

2.1 Relativization from an ayay-gap

The standard account of the syntax and semantics for externally headed relatives in languages like English postulates a gap in argument position inside the relative which is syntactically bound by an operator at the CP level. Semantically, the gap is interpreted as an individual variable, a variable ranging over individuals, which is abstracted over at the CP level. The analysis typically involves some account of how the external head fits into that, but since there is no external head in internally headed relatives, we can skip over the latter here. It is the syntax of the operator that accounts for the island effects.

The fact that internally headed relatives show island effects is easiest accounted for by the assumption that *the same* operator-variable construction mechanism is in fact operative in Japanese internally headed relatives. Since nothing of this is visible on the surface, I assume that the gap is an '**i**nvisible **i**ndividual gap' or in short, an 'ayay gap':

> **Assumption 1:** The internally headed relative contains an ayay gap.
> Internally headed relatives contain an operator-variable construction, which involves abstraction over an individual variable corresponding to a DP gap in argument position. Neither operator nor gap are visible on the surface.

In English, DP gaps are usually visible on the surface, because usually DP gaps occur in obligatory argument positions. Thus, for instance, in adverbial PPs, if the DP moves out of the PP, the DP-gap is made visible on the surface by the stranded preposition. Gaps that are invisible on the surface are naturally associated with adverbial constructions. If it is the full PP in adjunct position that moves, the gap is invisible, because the adjunct position is an optional position. Whether or not an invisible gap is an ayay gap depends on the semantic interpretation of the abstraction involved (over an individual variable, or over a PP-entity variable), which is not an issue I want to resolve for PPs here.

True ayay gaps are found in English with bare NP adverbs, discussed in Larson (1985) and Rothstein (1995). Bare NP adverbs are expressions that look like DPs but pattern in every way with adverbials. Examples are *Tuesday* in (9a) and *every day* in (9b):

(9) a. *Tuesday*, we visited Amsterdam.
b. We visited a different city *every day*.

Rothstein (1995) assumes that *Tuesday* and *every day* in (9) pattern with adverbials because they are PPs with a null preposition (a null-version of *on*) in adverbial position:

[$_{PP}$ [$_{P}$ e] [$_{DP}$ *every day*]]

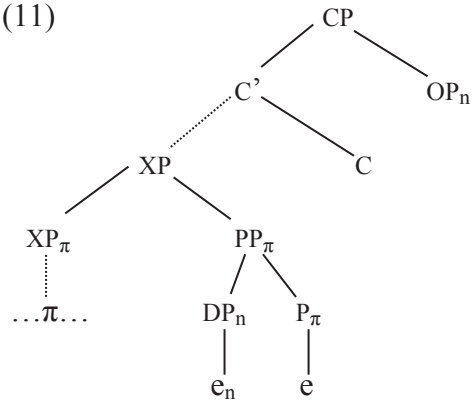
Larson gives a somewhat different account, but for our purposes the differences are irrelevant. What *is* relevant here is that we can make *day* in *every day* the external head of a relative clause, as in (10):

(10) a. I wrote down in my notebook *the day* they told us we would visit Amsterdam.
b. In fact, I circled in my notebook *every day* they told us we would be in Holland.
c. I wrote down in my notebook
[$_{DP}$ *every day* [$_{CP}$ **OP$_n$** they told us [$_{CP}$ we would be in Amsterdam **[$_{PP}$ [$_{P}$ e] [$_{DP}$ e$_n$]]**]]]

The relevant reading in (10a) is the reading which expresses that the day in question is the day on which we would visit Amsterdam, according to 'them', *not* the day on which they told us so. The relative clause is part of a DP in argument position, and provides in all respects the same restriction on the determiner or quantifier that relatives do when the head noun is a property of individuals. Given this, it is reasonable to assume that (10b) is analyzed on the model of (10c). This means that the relativization in (10) is a true example of an ayay gap in English: the DP gap is invisible because the preposition is also null.

Since PPs with empty prepositions clearly constitute a phenomenon that exists across languages, and since the analysis I will give is most naturally formulated in terms of the semantics of a (null) preposition, I propose to take this case as a model for the analysis of Japanese internally headed relatives and suggest the following syntactic analysis.

(11)



Note that Japanese has postpositions rather than prepositions. I take Japanese noun phrases in argument position to be DPs rather than NPs, but nothing hinges on this assumption. π stands for the internal head. The π-indices on the nodes are meant for easy reference: PP$_\pi$ is the null PP containing the ayay-gap, XP$_\pi$ the structure that contains the internal head and that PP$_\pi$ adjoins to.

2.2 The semantics of pp$_\pi$

With Grosu & Landman (2012), I assume a neo-Davidsonian semantics. I give a brief overview:

–Verbs and (extended) projections of the verb denote event types, sets of eventualities, events or states. I will use *events* for short. '→' stands for 'is interpreted as'.

(12) $[_{V}$ *butter*$] \rightarrow$ $\lambda e.butter(e)$ The set of buttering events

–Thematic roles are partial functions from events into event participants. The interpretations of DP arguments are combined with event type interpretations through thematic roles (specified in the theta grid of the verb). I assume that the DP-argument is interpreted, relative to a role in the theta grid, as an event type which intersects with the event type of the (extended) projection of the verb the DP combines with:

(13) $[_{DP}$ *a bun*$]$ + Th $\rightarrow$ $\lambda e.bun(Th(e))$ The set of events with a bun as theme

(14) $[_{VP}$ *butter a bun*$] \rightarrow$ $\lambda e.butter(e) \cap \lambda e.bun(Th(e)) =$
$\lambda e.butter(e) \wedge bun(Th(e))$ The set of buttering events with a bun as theme

In neo-Davidsonian semantics this same interpretation strategy applies to the combination of PPs with (extended) projections of the verb, regardless of whether the preposition is selected by the verb or whether the PP is an adjunct. The P-element (preposition or postposition) is interpreted as a thematic role, the PP is interpreted as an event type, which intersects with the verbal event type:

(15) $[_{PP}$ *with a knife* $] \rightarrow$ $\lambda e.knife(Instr(e))$ The set of events that have a knife as instrument

(16) $[_{VP}$ *butter a bun with a knife*$] \rightarrow$
$\lambda e.butter(e) \wedge bun(Th(e)) \cap \lambda e.knife(Instr(e)) =$
$\lambda e.butter(e) \wedge bun(Th(e)) \wedge knife(Instr(e))$
The set of buttering events with a bun as theme and a knife as instrument

At the IP level, event existential closure takes place.[6] Before existential closure (including the subject and past tense):

(17) $[_{IP}$ *Fred buttered a bun*$] \rightarrow$
$\lambda e.butter(e) \wedge Ag(e) = Fred \wedge bun(Th(e)) \wedge Time(e) < now$
The set of buttering events with Fred as agent, a bun as theme and running time before now

After existential closure:

(18) $[_{IP}$ *Fred buttered a bun*$] \rightarrow$
$\exists e[butter(e) \wedge Ag(e) = Fred \wedge bun(Th(e)) \wedge Time(e) < now]$
There is a buttering event with Fred as agent, a bun as theme and running time before now.

The PP-interpretation follows the following general schema:

If P $\rightarrow$ *P* and DP $\rightarrow$ *DP* then PP $\rightarrow \lambda e.DP(\lambda x.P(e) = x)$

[6] For extended discussion and caveats, see Landman (2000).

We come back to PP_π and XP_π:

Assumption 2a: PP_π adjoins to structure XP_π and XP_π has an event type interpretation.

This means that if XP_π is, say, an IP, PP_π is adjoined *before* event existential closure. With this, the basic semantics of PP_π and of XP is determined:

(19)

Let XP_π	$\rightarrow E_\pi$	An event type
$[_{PP}\ e_n\ P_\pi]$	$\rightarrow \lambda e.P_\pi(e) = x_n$	The set of events whose P_π-participant is x_n
XP	$\rightarrow \lambda e.e \in E_\pi \wedge P_\pi(e) = x_n$	The set of events in E_π whose P_π-participant is x_n

What is P_π? Here I follow Grosu & Landman (2012): in the semantic derivation of the interpretation of XP_π, the interpretation of the internal head π fills a role R_π. This role is chosen as the interpretation of the null preposition in PP_π:

Assumption 2b: P_π is interpreted as the role R_π that is used in the derivation of XP_π to connect the interpretation of internal head π to the event type of the relevant (extended) projection of the verb.

So we derive:

(20)

PP_π	$\rightarrow \lambda e.R_\pi(e) = x_n$	The set of events whose R_π-participant is x_n
XP	$\rightarrow \lambda e.e \in E_\pi \wedge R_\pi(e) = x_n$	The set of events in E_π whose R_π-participant is x_n where R_π is the role specified in assumption 2b

This means that, if we choose, say, the Theme role Th for R_π, we derive, for the structure in which PP_π is adjoined to the IP before existential closure:

(21) $[_{IP}\ PP_\pi\ [_{IP}$ *Fred buttered a bun*$]] \rightarrow$
$\lambda e.$*butter*$(e) \wedge Ag(e) = Fred \wedge$ *bun*$(Th(e)) \wedge Time(e) < now \wedge Th(e) = x_n$
The set of past buttering events with Fred as agent, and as theme a bun and x_n as theme

Thus, *de facto* the theme role is constrained twice.[7]

2.3 Participant relations and the locality of the internal head

The analysis given above is formulated not in terms of the internal head π, but in terms of the role R_π that connects π to the event type interpretation of the relevant (extended) projection of the verb.

In fact, the analysis does without the notion of *internal head*. I will make this aspect of the analysis explicit by introducing a notion of *participant relation*. I will concentrate here on the basic case.

We consider a structure XP, an (extended) projection of a lexical verb V, where $V \rightarrow V$ and $XP \rightarrow XP$, and V and XP are event types such that $XP \subseteq V$. The neo-Davidsonian theory sketched above uses the same semantic mechanism for interpreting DP-arguments in XP, relative to roles in the theta grid of V, as it does for DP objects of PP-adjuncts in XP, where the role is provided by the preposition.

The *participant relation* for XP interprets the XP semantically as an n-place relation between the interpretations of the n DPs that are in one of these two ways grammatically realized in XP:

[7] For general discussion and other cases of roles constrained more than once, see Landman (2000) on the Unique role requirement in neo-Davidsonian event semantics.

Participant roles
Let R be a thematic role defined on the events in *XP*.
R is a **participant role** for XP if there is a DP realized in XP, as an argument or the argument of an adjunct PP, and R is the role that adds the interpretation *DP* of DP via intersection of $\lambda e.DP(\lambda x.R(e) = x)$ and the event type interpretation of the relevant (extended) projection of V, i.e. the one that is the sister of the DP or its PP.

Participant relation
Let XP be an (extended) projection of V, XP $\rightarrow$ *XP*, V $\rightarrow$ *V*, *XP* $\subseteq$ *V*.
$<$*XP*, R_1,…,$R_n>$ is the **participant relation** of XP iff $R_1 \ldots R_n$ are the participant roles for XP.

I will call the DPs corresponding to the participant roles in the participant relation of XP the **arguments of the participant relation**.

Two examples:

(22) Fred quickly buttered a bun with a knife.

In (22), the roles Ag, Th, Instr, Manner and Time constrain the IP-event type grammatically, Time is introduced by the tense, Manner by the adverb, the others link interpretations of syntactically realized DPs intersectively to the event type. This means that the participant relation of the IP is:[8]

(23) $<$*IP*, Ag, Th, Instr$>$, where *IP* is:
$\lambda e.butter(e) \wedge Ag(e) = Fred \wedge bun(Th(e)) \wedge knife(Instr(e)) \wedge quick(Manner(e)) \wedge Time(e) < now$

(24) Fred buttered a bun at midnight.

In (24), the roles Ag, Th and Time are participant roles. Note that the Time role is, so to say, introduced twice, by the tense and by the PP *at midnight*. The latter makes the Time role a participant role in (24):

(25) $<$*IP*, Ag, Th, Time$>$, where *IP* is:
$\lambda e.butter(e) \wedge Ag(e) = Fred \wedge bun(Th(e)) \wedge midnight(Time(e)) \wedge Time(e) < now$

We can now reformulate Assumption (2b) from the previous section without making reference to the internal head π:

Assumption 2b: P_π is interpreted as one of the roles in the participant relation of XP_π.

With this revision of the theory, we can in fact *introduce* π, i.e. define π: the interpretation of P_π is identified with a role R_π in the participant relation of XP_π; the DP in XP_π whose interpretation fills that role is π.

We derive the following corollary:

Corollary: In $[_{XP}\ XP_\pi\ PP_\pi]$, the ayay-gap and the internal head π are ***co-arguments*** in the participant relation of XP.

[8] The participant relation determines the following relation with three DP-related arguments:
$\lambda x_3 \lambda x_2 \lambda x_1 \lambda e.butter(e) \wedge Time(e) < now \wedge quick(Manner(e)) \wedge$
$\mathbf{Ag}(e) = Fred \wedge \mathbf{Ag}(e) = \mathbf{x_1} \wedge bun(\mathbf{Th}(e)) \wedge \mathbf{Th}(e) = \mathbf{x_2} \wedge knife(\mathbf{Instr}(e)) \wedge \mathbf{Instr}(e) = \mathbf{x_3}$

The participant relation of XP_π is an n-place relation, and π is an argument of that relation. But PP_π is an adjoined PP, hence XP, the mother of XP_π and PP_π, determines an n + 1-place participant relation (adding role R_π once more, this time in relation to the ayay-gap), and both the ayay-gap and π are arguments of that participant relation. The fact that this corollary follows directly from the theory is the main reason why I prefer to take the phrase containing the ayay-gap to be a null PP, rather than some new kind of null functional category, as was assumed in Grosu & Landman (2012).

Let me take stock. In the hybrid analysis of internally headed relatives, the relative contains a DP-gap (the ayay-gap) as part of a null PP, PP_π, and this gap forms a standard operator-variable relation with an operator at the CP-level of the relative: that is, the ayay-gap is interpreted as an individual variable x_n which is bound by an operator at the CP-level. PP_π is adjoined to a node XP_π which we take to be an (extended) projection of a verb with an event type interpretation.

The second plank of the hybrid analysis concerns the interpretation of the null preposition P_π. I associate with $[_{XP}\ XP_\pi\ PP_\pi]$ a *semantic* object, the participant relation of XP, and restrict the interpretation choice for P_π to the other participant roles specified in that relation.

While the participant relation is a semantic object, it is constructed from a syntactic structure containing an (extended) projection spine from a lexical verb up to XP, with DPs – the internal head π among them – connecting to it as arguments or via prepositions. By this construction, the relation between XP, the DP arguments of the participant relation of XP and V is 'local' in the following sense:

'Locality':[9] –The arguments of the participant relation of XP cannot occur in a clause embedded in XP.
–There cannot be a syntactic island in XP between V and any of the arguments in the participant relation of XP.

Corollary: –The internal head cannot occur in a clause embedded in XP_π
–There cannot be a syntactic island between the ayay-gap and the internal head π.

What this means is that on the hybrid analysis, PP_π is adjoined to the extended projection that π belongs to. π *can* occur embedded in a clause in the relative, but only if the ayay-gap can. So embedding is to do with the operator-ayay gap relation, not with the ayay gap-internal head relation.

This means that in the relative in the felicitous example (7a), with internal head π = *juuyouna kasetsu*-'important hypothesis', PP_π is attached to IP_2, the lowest IP dominating the internal head:

(26) a. [[John-ga [zibun-no gakusei-ga
John-NOM self-GEN student-NOM
juuyouna kasetsu-o teian-shi-ta to $_{IP2}$] [**DP**$_n$ **P**$_\pi$] [jimanshite-ita-**no** $_{IP1}$] **O**$_n$ $_{CP}$]
important hypothesis-ACC propose-do-PAST-to boasted-had-**no**

PP_π could not be adjoined to the higher IP, IP_1, because π is not an argument of the participant relation of IP_1.

[9] I use quote marks to stress that 'locality' as used here is not meant as a technical term. I take the relation in question to be a derived relation definable in terms of the formal locality conditions of a standard syntactic theory.

π *is* an argument of the participant relation of IP$_2$, so PP$_\pi$ can be adjoined to IP$_2$. We assume that from PP$_\pi$, adjoined to IP$_2$, the operator O$_n$ can move freely to CP, hence the grammar allows (26a), and (7a) is felicitous.

In the infelicitous example (7b), with internal head π = *atarashii kasetu*-'new hypothesis', we similarly cannot adjoin PP$_\pi$ to the higher IP, IP$_1$, as in (26b$_1$):

(26) b$_1$.[[[John-ga
John-NOM
[[[*atarashii kasetu-o*]$_\pi$ teianshita $_{IP2}$] gakusei-o $_{DP}$] homete-ita-**no** $_{IP1}$] [**DP**$_n$ **P**$_\pi$]] **O**$_n$ $_{CP}$]
new hypothesis-ACC proposed student-ACC praise-had-**no**

The reason is the same as for (26a): π is not an argument of the participant relation of IP$_1$. As above, π *is* an argument of the participant relation of IP$_2$, so PP$_\pi$ *can* be adjoined there, as in (26b$_2$):

(26) b$_2$ [John-ga
John-NOM
[[[[*atarashii kasetu-o*]$_\pi$ teianshita $_{IP2}$] [**DP**$_n$ **P**$_\pi$] gakusei-o $_{DP}$] homete-ita-**no** $_{IP1}$]
new hypothesis-ACC proposed student-ACC praise-had-**no**

But then the operator O$_n$ cannot move to CP, because the ayay gap is inside the island (IP inside DP). So we predict the island effect: (7b) is infelicitous.

2.4 Comparison with Grosu & Landman (2012)

The present analysis in terms of participant relations is inspired by Reinhardt & Reuland's (1992) relational analysis of reflexivity in terms of the notion co-argument of a semantic predicate (but building relations at a higher level than they did). While the basic analysis as given here suffices for the cases discussed in this paper, obviously both the notion of participant relation and the role identification mechanism need to be extended to deal with more complex cases.

With respect to the participant relation, I am here only looking at IPs where the event type interpretation is a subset of the event type interpretation of the verb: this does not deal, for instance, with the possibility of the derivation involving a more articulated event structure, either as part of a more complex V structure (with DP-arguments relating to sub-event structure), or through aspectual or modal operations (with DP-arguments relating to super-event structure, event structure derivationally introduced), nor does it address predicative structures. Similarly, extension of the analysis to conjunction cases, like the ones discussed in Grosu & Landman (2012: Section 6.2), requires an extension of the notion of participant relation.

Other cases are more straightforward to deal with: Grosu & Landman (2012: Section 6.1) discusses cases where the interpretation of P$_\pi$ is derived from *two* roles in the participant relation. Their analysis can be taken over here without much change.[10]

The main difference between the present analysis and that of Grosu & Landman (2012) lies in what we accept as a role in the event type interpretation of IP$_\pi$. In the theory

[10] Instead of setting the interpretation of PP$_\pi$ to one of the roles in the participant relation, you set it to the sum role of two such roles, as defined by Grosu & Landman (2012).

presented here, I propose a strict view on thematic roles: thematic roles specify event participants. While I am well aware that there is leeway in what we may or may not intuitively count as a participant of a given event, I want the theory to be as strict as possible about this. So, to give an extreme example, I do not want – without solid grammatical reason – to allow the interpretation of the DP *a bun* in the relative clause in (27) to fill a participant role on the main clause event type of Fred typing a letter:

(27) Fred, who was eating a bun, typed a letter.

In an unconstrained theory of roles, the function that maps letter-typing event e onto the theme of accompanying bun-eating event could be a perfectly well defined role. But, if this function can be a participant role, the notion of participant relation obviously no longer corresponds to a syntactic structure that encodes any notion of syntactic locality, and the locality condition on the relation between the ayay-gap and the internal head would have to be stipulated independently.

This is, of course, an extreme case, but I now believe that Grosu & Landman's analysis suffers from exactly this problem: at the basis of their analysis lies what they call a 'liberalized' notion of role which is meant to allow for what they call 'bridging' cases. Look at the contrast between (28a) and (28b):[11]

(28) a # [Taro-ga *zibun-no musume-no hito-ri-no* sushi-o kyaku-ni
[Taro-NOM *his daughter*-GEN 1-CLF-GEN sushi-ACC guest-DAT
dasita-**no**]-o kyaku-ga suguni home-ta.
served-**no**]-ACC guest-NOM immediately praise-PAST
The guest immediately praised: *[the one of his$_i$ daughters such that…]*
Taro$_i$ served to the guest the sushi of *one of his$_i$ daughters*.

b ✓[Taro-ga daidokoro-no *zibun-no musume-no hito-ri-no* sushi-o
[Taro-NOM kitchen-GEN *self*-GEN *daughter*-GEN 1-CLF-GEN sushi-ACC
kyaku-ni dasita-**no**]-o kyaku-ga suguni home-ta.
guest-DAT served-**no**]-ACC guest-NOM immediately praise-PAST
The guest immediately praised: *[the one of his$_i$ daughters such that…]*
Taro$_i$ served to the guest the sushi of *one of his$_i$ daughters*, who was in the kitchen.

(28a) derives from an example originally discussed in Shimoyama (2001). Shimoyama noted the infelicity of the example similar to (28a) and suggested that this infelicity is due to the fact that the genitive DP *zibun-no musume-no hito-ri-no*-'one of his daughters' is not an argument of the participant relation for the IP; to cite Shimoyama: "It seems to be the case that only thematic role bearers of the event in the lower clause can be the internal head." (Shimoyama 2001: 143). This is, of course, exactly what I am proposing here.

Against this, Grosu & Landman suggested that the infelicity of examples like (28a) is due to Kuroda relevancy effects, and they give an example (due to Koji Hoshi), similar to (28b), which like (28b) and unlike (28a), *is* felicitous. Grosu & Landman's idea is that the extra information about the daughter being in the kitchen while the meal goes on provides the more intimate connection between the sushi serving and praising that allows (28b) to satisfy the Kuroda relevancy condition, where (28a) does not.

[11] The examples and judgements are due to Koji Hoshi, and differ for reasons of ease and clarity in unimportant ways from the examples given Grosu & Landman (2012).

In (28b) the internal head is *zibun-no musume-no hito-ri-no*-'one of his daughters' which is *neither* an argument in the participant relation of the IP, nor linked to the serving event type via a normal thematic role (the sushi is, the daughter is not).

The contrast in (28) plays a fundamental role in the analysis of Grosu & Landman (2012) (and in fact, in presentations of earlier versions of this paper). To deal with the felicity of cases like (28b), Grosu & Landman allow the role R_π to be identified with a 'liberalized' role, a role that *is* defined on the event type interpretation of XP_π, but is not a participant role in my sense. The role in question is the function which takes events e of Taro serving the theme of e and maps them onto the person who fills *in* e the role of being the agent of an *accompanying* event of preparing the theme of e, or an accompanying state of having prepared the theme of e.[12]

The problem is that this is, of course, *exactly* the kind of role that we didn't want to allow in (27). And the problem for Grosu & Landman's analysis is that, if you allow R_π to pick up this kind of 'bridging role', there is actually no constraint on where in XP_π the internal head is located. This means that, on closer inspection, there is actually nothing in Grosu & Landman's analysis that enforces locality, i.e. nothing that guarantees that the ayay-gap and the internal head are *not* separated by an island. And this means that, in order to predict the island effects observed, their analysis actually needs to be *supplemented* with a further syntactic locality constraint. Note that the problem is not to do with the syntactic theory, but with the fact that, by allowing bridging roles, Grosu & Landman's analysis does not properly constrain *where* the internal head can be inside XP_π.

The idea of the present analysis is, of course, that further locality constraints are not needed, because the present analysis tries to define the role-identification relation from the start as affecting co-arguments in a participant relation which is derived from a syntactic structure in which these arguments are 'local'.

So the present analysis *does* predict the island effects without further locality conditions. But then the obvious question is: what about the bridging data that motivates the analysis of Grosu & Landman, the felicity of (28b)?

This is where Grosu & Koji (2016), comes in. If (28a) and (28b) are internally headed relatives, and the difference in felicity is due to Kuroda relevancy, then the felicity contrast between (28a) and (28b) will be preserved if the examples are put in the context of the tests provided for internally headed relatives in Grosu & Koji (2016). In particular, Grosu & Koji (2016) argues that internally headed relatives can be split headed. The examples in (29) are split-headed versions of the examples in (28).[13]

(29) a. #[Taro-ga *zibun-no* *musume-no* sushi-o kyaku-ni dasi-ta-**no**]-o
Taro-NOM *his* *daughter*-GEN sushi-ACC guest-DAT serve-PAST-**no**-ACC
hito-ri kyaku-ga suguni home-ta.
1-CLF guest-NOM immediately praise-PAST
The guest immediately praised *[the daughter such that…]*
Taro served to the guest the sushi of *his one daughter*.

In this case *hito-ri*-'one'-CLF can not have a partitive meaning, hence the purported meaning expressed is *his one daughter*. The classifier selects for humans, so the sushi cannot be the internal head. And the example is infelicitous. This is, of course, not surprising given the infelicity of (28a). We look at (29b), which corresponds to (28b):

[12] i.e. the complex role: $\lambda e.\sigma(\lambda x.\exists e'[acc(e) = e' \wedge \textit{prepare}(e') \wedge Th(e') = Th(e) \wedge Ag(e') = x])$

[13] The examples are, again, due to Koji Hoshi.

(29) b. #[Taro-ga [daidokoro-no *zibun-no musume*]-no sushi-o kyaku-ni
Taro-NOM kitchen-GEN *his daughter*-GEN sushi-ACC guest-DAT
dasi-ta-**no**]-o *hito-ri* kyaku-ga suguni home-ta.
serve-PAST-**no**-ACC 1-CLF guest-NOM immediately praise-PAST
The guest immediately praised *[the daughter such that…]*
Taro served to the guest the sushi of *his one daughter who was in the kitchen.*

The crucial observation is that (29b) is judged as infelicitous as (29a). This means that the phrase that expresses the connection between the serving and praising, that supposedly allowed (28b) to satisfy Kuroda relevancy, has actually no effect on felicity.

But that means that bridging examples like (28b), which formed the basis for the 'liberalized role analysis' of Grosu & Landman (2012), are a red herring: according to the tests, the felicity of (28b) can not be attributed to Kuroda relevancy effects in internally headed relatives, because in that case we would expect (29b) to be felicitous. The felicity of (28b) must be due, thus, to the possibility of analyzing (28b) as some other construction than as an internally headed relative.

This obviously doesn't address the very interesting question of what *does* account for the contrast in (28a,b), if it isn't the Kuroda relevancy condition for internally headed relatives. But that is not something to be resolved in the present paper. For our purposes here, the relevant conclusion is that the contrast in (28a,b) is no reason to liberalize the notion of role along the lines of Grosu & Landman (2012). Hoshi's example (28b) turns out to be a red herring. This means that Shimoyama's suggestion, taken up by me here, that in internally headed relatives the internal head must fill a participant role can be maintained. With that, the present analysis provides better results than that of Grosu & Landman (2012), with a semantically simpler, and grammatically more constrained notion of role.

2.5 The basic semantics, an example

We illustrate the semantic derivation of the relative (more details in Grosu & Landman 2012):

(1) ✓Taro-wa [Yoko-ga reezooko-ni *kukkii-o sukunakutomo mit-tsu*
Taro-TOP [Yoko-NOM refrigerator-LOC *cookie*-ACC *at least* *3*-CLF
irete-oita-**no**]-o paatii-ni motteitta.
put-AUX-**no**]-ACC party-to brought
Taro brought to the party: *[the sum of all the cookies such that…]*
Yoko put *at least three cookies* in the refrigerator.
'Yoko put at least three cookies in the refrigerator. Taro brought them to the party.'

We assume we have put together the IP-semantics: IP $\rightarrow E_\pi$:

(30) $E_\pi = \lambda e.\textit{put}(e) \wedge Ag(e) = Yoko \wedge \textit{cookies}(Th(e)) \wedge |Th(e))| \geq 3 \wedge \textit{fridge}(Into(e))$
The set of (sums of) putting events with agent Yoko, theme a sum of at least three cookies, and Into-role the fridge
Participant roles: Ag, Th, Into

Above we specified the semantics for adjoining PP_π to IP_π. IP $\rightarrow$ *IP*

$IP = \lambda e.P_\pi(e) = x_n \wedge e \in E_\pi$

We identify P_π with participant role Th, and we get:

(31) $IP = \lambda e.put(e) \wedge Ag(e) = Yoko \wedge cookies(Th(e)) \wedge |Th(e)| \geq 3 \wedge \mathbf{Th(e) = x_n} \wedge fridge(Into(e))$

Next, event existential closure takes place at the IP-level, and at the CP-level, where the operator is, abstraction takes place over variable x_n, binding that variable:

(32) $CP = \mathbf{\lambda x_n}.\exists e[put(e) \wedge Ag(e) = Yoko \wedge cookies(Th(e)) \wedge |Th(e)| \geq 3 \wedge Th(e) = \mathbf{x_n} \wedge fridge(Into(e))]$
The set of all sums of at least three cookies that were put in the fridge by Yoko (in some sum of events)

We have derived at the CP-level a predicate interpretation for the relative clause. The CP is in argument position in the matrix.[14]

I assume that the implicit definiteness operation σ brings the relative in argument position from a predicative meaning to a definite interpretation at the type of individuals.[15] This is similar to what Jacobson (1988; 1995) assumes for English free relatives in argument position.

With this, we derive as the interpretation of the internally headed relative clause:

(33) $\sigma(\lambda x.\exists e[put(e) \wedge Ag(e) = Yoko \wedge cookies(Th(e)) \wedge |Th(e)| \geq 3 \wedge Th(e) = x \wedge fridge(Into(e))])$
The sum of all cookies that Yoko put in the fridge (in some sum of events), presupposing that she put at least three cookies in the fridge

And this means that we derive as the interpretation for (1):

> Taro brought the cookies that Yoko put in the fridge to the party.
> Presupposition (brought in by the definiteness operator): Yoko put at least three cookies in the fridge.

3 Implementing Kuroda relevancy

3.1 The Kuroda relevancy condition

Kuroda showed that felicitous interpretation of the internally headed relative requires a relevancy connection. The Kuroda relevancy condition (Kuroda 1976–77; 1992; 1999) can be formulated as follows:

The Kuroda relevancy condition

a. *The Relevancy Condition*
For an internally headed relative to be acceptable, it is necessary that it be interpreted pragmatically in such a way as to be directly relevant to the pragmatic content of its matrix clause.

b. *Sub-condition*
The two events represented by the internally headed relative and the matrix clause involve the same temporal interval and the same location.

[14] This is meant as a semantic description. I do not take any position here on the syntactic articulation of this part of the structure (i.e. whether the structure is syntactically a CP in DP position with *no* as C, whether there is a null determiner, or whether *no* is a nominalizator or a null D, see the works by Kuroda, Hoshi, Shimoyama and Grosu mentioned for ample discussion.

[15] σ(P) is the sum of the elements in P, on the presupposition that that sum itself is in P.

For discussion and modification of the sub-condition, see Kim (2007), Grosu (2010), Grosu & Landman (2012) and Grosu & Hoshi (2016). While I am in this paper mainly concerned with the question of how to enforce the Kuroda relevancy condition as a felicity condition, I will suggest a reformulation here.

The Kuroda relevancy condition was illustrated with the examples in (2):

(2) a. #[Daidokoro-no mado-kara siroi neko-ga haitte-ki-ta]-**no**]-ga
kitchen-GEN window-from white cat-NOM came-in-PAST-**no**]-NOM
kesa mata yattekita.
this-morning again came
[*[The cat such that…]* a white cat came in from the window]
came back this morning.
'A white cat came in from the kitchen window; she came back this morning.'

b. ✓[Daidokoro-no mado-kara siroi neko-ga haitte-ki-ta]-**no**]-ga
kitchen-GEN window-from white cat-NOM came-in-PAST-**no**]-NOM
akana-o totte nigeta.
fish-ACC steal ran-away
[*[The cat such that…]* a white cat came in from the kitchen window]
stole a fish and ran away.
'A white cat came in from the kitchen window; she stole a fish and ran away.'

I note first that, while the examples in (2) allow other structural analyses besides internally headed relatives, the contrast in felicity judgements in (2a) and (2b) *is* preserved under the applicable test for internally headed relatives proposed in Grosu & Hoshi (2016). I will stick with the examples that are potentially structurally ambiguous, but the facts are the same for the more complex disambiguated examples.

Kuroda relevancy is the observation that the event of the white cat coming in does not bring her enough on the scene for (2a) to be felicitous. In (2b) the scene with the white cat coming continues in the main clause with her stealing the fish. This *is* enough to bring her on the scene, and (2b) is felicitous. This fits with the spatio-temporal overlap clause: the sentence is presented as observing one extended region including the coming in, the stealing, and the leaving.

However, the temporal overlap clause is too strong for felicitous examples like (18):

(34) a. ✓Taro-wa [[Yoko-ga asa daidokoro-de sushi-o tukutta]-**no**]-o
Taro-TOP Yoko-NOM morning kitchen-in sushi-ACC made-no-ACC
yoru-ni okyaku-ni hurumatta.
evening-in guest-to served
Taro served the guest at night *[the sushi such that]*
Yoko made *sushi* in the kitchen in the morning.

b. ✓Yoko-wa [[Taro-ga yoru-ni sushi-o okyaku-ni hurumatta]-**no**]-o
Yoko-TOP Taro-NOM evening-in sushi-ACC guest-to served-no-ACC
asa daidokoro-de tukutta.
morning kitchen-in made
Yoko made in the kitchen in the morning *[the sushi such that]*
Taro served the guest *sushi* at night.

In these examples it is presumably what we could call the *rhythm* of the events: 'made-in-the-morning – served-in-the-evening' which provides the relevant connection. Note too that the felicity of both these examples requires a *symmetric* formulation of the Kuroda

connection (it won't do to require, say, that the matrix event should overlap a result state of the internal event, because that cannot deal with (34b)). I propose a (still very informal) formulation in terms of *group-event or singular process* formation:

> **The Kuroda relevancy condition (reformulated)**:
> The two events represented by the internally headed relative and the matrix clause must be in the context naturally interpretable as part of a *single* natural process (a group event).
>
> Events e_1 and e_2 are **Kuroda-related** iff e_1 and e_2 satisfy (in context) the Kuroda relevancy condition.

Thus, in the context of (34), the relevant events can be seen as part of a single process – *make the sushi–let it rest–serve the sushi* – which is contextually present in the matrix both in (34a) and (34b). In (2a) the event of the cat coming in the past and the event of the cat coming in today are presented as *two single events*, and *not as one process*.

That the notion of *single process* is on the right track is suggested by the following examples. Compare the infelicitous (2a) with (35):

(35) [Haiiro-no neko-ga kinou mado-kara haitteki-ta-**no**]-ga
gray-GEN cat-NOM yesterday window-from came-in-PAST-**no**-NOM
kesa mata soto-ni tobi-dasita.
this-morning again jumped out
[*[The cat such that…]* a gray cat came in from the window yesterday]
jumped out again this morning.

The main difference between (35) and (2a) is that the event of the cat coming in yesterday and the cat jumping out again today are naturally seen as (part of) one process, and (35) is felicitous.

Even stronger is the following observation. Landman & Rothstein (2009) show that certain interactions of various kinds of plural noun phrases with aspectual operators are best understood by assuming that pluralities of events get reanalyzed as *single processes*: e.g. they argue that aspectually, iterations of events are no longer event pluralities, but singular processes. Inspired by this, (36) varies (2a) by introducing an iteration:

(36) [Haiiro-no neko-ga iti-nen-mae-ni mado-kara haitteki-ta-**no**]-ga
gray-GEN cat-NOM one-year-ago window-from came-in-PAST-**no**-NOM
sore-o soreirai zutto mai asa yattei-ru.
that-ACC since ever every morning has done
[*[The cat such that…]* a gray cat came in from the window a year ago]
has done that every morning since.

In (36), the event introduced in the relative clause is not simply regarded as one of a multitude of events, but as *the first stage of a single iterative process*. Unlike (2a), (36) is felicitous. This is rather compelling evidence that what is at stake in Kuroda relevancy is indeed single process formation.

While I think that the heart of Kuroda relatedness is indeed the plausibility of regarding the events as forming in context a singe process, I think that the role of context here should not be over-emphasized. While the context obviously plays a role, it cannot *all by itself* provide the clues that make the events form a natural single process. Thus, take any internally headed relative which is infelicitous because the relevant events involved do not naturally form a single process. Set up a pragmatic context where you *make* these

events explicitly part of a single process. It is not clear that that will, in general, be sufficient to make the relative felicitous. If so, the notion of Kuroda relatedness is more semantically constrained than assumed in Kuroda's own formulation of the condition: the natural, contextual interpretation as a single process must be derived *not just* from the context, but from the context *and* the semantic material provided by the sentence interpretation. Kuroda relatedness, then, should be constrained accordingly.[16]

3.2 Kuroda functions in a Lombardian presupposition mechanism

I am not concerned in this paper with giving more content to Kuroda relevancy than the suggestions in the previous subsection. I am concerned with how to *enforce* the constraint as a felicity condition in the grammar. This section works out a proposal to that effect.

Let us fix some notation:

> $\mathbf{E}_\pi$ is the event type which is the interpretation of XP_π, the structure that PP_π adjoins to.
> $\mathbf{E}_\mu$ is the event type which is the interpretation of the matrix, the structure in which the relative clause fills an argument position. (μ is mnemonic for *matrix*)
> $\mathbf{R}_\pi$ is the role in the participant relation of XP_π that the interpretation of P_π is identified with.

Kuroda relevancy relates events in event type E_π to events in event type E_μ. We will enforce Kuroda relevancy via a function from E_π into E_μ, which I call a *Kuroda function*:

> A **Kuroda function** is a contextually salient partial function **k** from E_π into E_μ such that for every $e \in E_\pi$: if **k**(e) is defined, then e and **k**(e) are Kuroda-related (in the context).
>
> Standard notion of domain: $\text{dom}(\mathbf{k}) = \{e_1 \in E_\pi: \mathbf{k}(e_1) \text{ is defined}\}$

The semantics is going to make reference to a Kuroda function in the course of the derivation. But this is actually not quite trivial. The reason for this is that at the level of XP_π, event type E_π is accessible, but event type E_μ, the event type of the matrix, is not: at the level of XP_π *there isn't yet* an accessible event type of the matrix, because there isn't yet a matrix. On the other hand, at the level of the matrix, where event type E_μ is accessible, event type E_π is *no longer* accessible, because event existential closure has taken place, making E_π semantically inaccessible.

In other words, in order to implement the felicity condition, we need a presuppositional mechanism that allows for a connection between event types E_π and E_μ, even though there is no derivational stage at which both are accessible. I propose a presuppositional mechanism that works somewhat along the lines of Renaissance economics. I call the mechanism *Lombardian*:

> **Lombardian banking:**
> Stage 1: You take out a loan – the bank checks your credit rating.
> Stage 2: You pay back the loan – you pay the interest.
>
> The **Lombardian presupposition mechanism** is a mechanism that regulates the establishment in context of an appropriate salient Kuroda function. It is a presupposition mechanism that operates along Lombardian principles in the course of the semantic derivation: borrow at E_π – pay back at E_μ.

[16] I thank Chris Tancredi for pertinent discussion concerning this issue.

We start out at the level where PP_π adjoins to XP_π, with E_π the interpretation of XP_π.

We are building a semantic derivation. We have come to level E_π and the interpretation of PP_π. It is our task to link E_π to a salient Kuroda function. We can't do this, because we don't *have* a Kuroda function, for the reasons given. What do we do? We *borrow* a function: we extend the interpretation of PP_π, and introduce a functional variable and an event variable over its range:

Stage 1a: Borrowing
Let **k** be a variable over (partial) functions from events into events and let e_μ be a variable over events.

$PP_\pi \rightarrow PP_\pi$, where:

$$PP_\pi = \lambda e.R_\pi(e) = x_n \wedge \mathbf{k}(e) = e_\mu$$

Variable **k** ranges over functions, but this variable will stay free and its value will ultimately be fixed as a salient function in the context. So instead of the expression **k** *ranges over functions such that…* I will use the expression: **k** *stands for a function such that…*

Next, we undergo a *credit check*: we *presuppose* at this stage that **k** stands for a function *from* E_π, i.e. a function whose domain is a subset of E_π. We introduce this presupposition by making the intersection operation, connecting the interpretations of PP_π and of XP_π, presuppositional:

Stage 1b: Credit check

$$[_{XP}\, XP_\pi\ PP_\pi] \rightarrow \begin{cases} \lambda e.e \in E_\pi \wedge\ R_\pi(e) = x_n \wedge \mathbf{k}(e) = e_\mu & \text{if } \mathbf{k} \text{ is a Kuroda function and} \\ & \text{dom}(\mathbf{k}) \subseteq E_\pi \\ \text{undefined} & \text{otherwise} \end{cases}$$

Note that the presupposition that **k** stands for a function *from* E_π does *not* mean that it is presupposed that *all* events in E_π are in the domain of **k** – that would be an unreasonable requirement – but only that *some* are. So far we are presupposing that **k** is a Kuroda function *from* E_π into *some other* set of events. We cannot at this stage require more.

The next Lombardian activity happens when we reach the matrix and the event type interpretation of the matrix. We derive an event type in which the borrowed variable e_μ is still unbound, and we haven't yet fixed more about **k** than that it is a function from events into events with domain E_π. I will call this event type E^μ (note: with a superscript μ). We now need to *pay back* the loan, *with interest*. *Paying back* means that we bind the free event variable by abstracting over it:

Stage 2a: Paying back
Given event type E^μ.
Form event type E_μ by binding e_μ in E^μ: $\lambda e_\mu.e_\mu \in E^\mu$

The *interest* is the presupposition introduced at this stage: that E_μ is the range of the function **k** and that **k** is a Kuroda function into E_μ. We do that by making the semantic binding operation presuppositional:

Stage 2b: Interest

$$E_\mu = \begin{cases} \lambda e_\mu.e_\mu \in E^\mu & \text{if } \mathbf{k}\text{: } E_\pi \to \lambda e_\mu.e_\mu \in E^\mu \text{ is a Kuroda function into } \lambda e_\mu.e_\mu \in E^\mu \\ \text{undefined} & \text{otherwise} \end{cases}$$

We have already presupposed that **k** stands for a Kuroda function with domain E_π. We now set the range of **k** to E_μ, making sure, of course, to continue to presuppose that **k** is indeed a Kuroda-function.

Thus, in two stages the Lombardian presupposition mechanism has built a presupposition linking E_π and E_μ via a Kuroda function. We will show, by discussing two examples, that this indeed means that 'matrix events' are presupposed to be Kuroda related to 'internal relative events'.

3.3 Two examples

The first example is (1), for which we have already gave the basic derivation in Section 2.5 above:

(1) ✓Taro-wa [Yoko-ga reezooko-ni *kukkii-o* *sukunakutomo* *mit-tsu*
Taro-TOP [Yoko-NOM refrigerator-LOC *cookie*-ACC *at least* *3*-CLF
irete-oita-**no**]-o paatii-ni motteitta.
put-AUX-**no**]-ACC party-to brought
Taro brought to the party: *[the sum of all the cookies such that…]*
Yoko put *at least three cookies* in the refrigerator.

The new derivation follows that given in Section 2.5. We derive at the IP level of the relative:

(37) $E_\pi = \lambda e.\textit{put}(e) \wedge \text{Ag}(e) = \text{Yoko} \wedge \textit{cookies}(\text{Th}(e)) \wedge |\text{Th}(e)| \geq 3 \wedge \textit{fridge}(\text{In}(e))$
IP $= \lambda e.e \in EP_\pi \wedge \mathbf{Th(e) = x_n} \wedge \mathbf{k}(e) = e_\mu$
Presupposition: **k** is a Kuroda function and dom(**k**) $\subseteq E_\pi$.

This means that we derive as the interpretation of the relative in the matrix:

(38) $\sigma(\lambda x.\exists e \in E_\pi\text{: } \text{Th}(e) = x \wedge \mathbf{k}(e) = e_\mu)$
Presupposition: **k** is a Kuroda function and dom(**k**) $\subseteq E_\pi$.

The matrix event type E^μ with variable e_μ still free is:

(39) $E^\mu =$
$\lambda e.\textit{bring}(e) \wedge \text{Ag}(e) = \text{Taro} \wedge \text{To}(e) = \text{the party} \wedge \text{Th}(e) = \sigma(\lambda x.\exists e' \in E_\pi\text{: } \text{Th}(e') = x \wedge \mathbf{k}(e') = e_\mu)$
Presupposition: **k** is a Kuroda function and dom(**k**) $\subseteq E_\pi$.

We presuppositionally bind event variable e_μ and get event type E_μ:

(40) $E_\mu =$
$\lambda e.\textit{bring}(e) \wedge \text{Ag}(e) = \text{Taro} \wedge \text{To}(e) = \text{the party} \wedge \text{Th}(e) = \sigma(\lambda x.\exists e' \in E_\pi\text{: } \text{Th}(e') = x \wedge \mathbf{k}(e') = e)$
Presupposition: **k**: $E_\pi \to E_\mu$ is a Kuroda function.

We do existential closure over the matrix and get:

(41) $\exists e[\textit{bring}(e) \wedge Ag(e) = Taro \wedge To(e) = the\,party \wedge Th(e) = \sigma(\lambda x.\exists e' \in E_\pi: Th(e') = x \wedge \mathbf{k}(e') = e)]$
Presupposition: $\mathbf{k}$: $E_\pi \rightarrow E_\mu$ is a Kuroda function.

This presupposes, as before, that Yoko put at least three cookies in the fridge. Look at the sum of all events of Yoko putting at least three cookies in the fridge. This sum is itself an event of Yoko putting at least three cookies in the fridge and its theme is the sum of all cookies that Yoko put in the fridge, hence the sentence expresses that there is an event of Taro bringing the theme of the sum of in-fridge-putting events to the party, an event which is presupposed to be Kuroda related to the sum of in-fridge-putting events.

This derivation is felicitous if variable **k** can be linked in the context to a salient Kuroda function. That is possible, if the context naturally allows the event of putting the cookies in the fridge and the event of taking them to the party to be regarded as stages of a single process. Since such an interpretation is readily available, there is no problem assuming that there is such a salient Kuroda function. The sentence is felicitous and we derive, informally:

(42) Taro brought *the cookies that Yoko put in the fridge* to the party.
Presuppositions: – Yoko put at least three cookies in the fridge.
– The event of putting the cookies in the fridge and the event of bringing them to the party are Kuroda-related.

As a second example, we look at the contrast between (2a) and (2b):

(2) a. #[Daidokoro-no mado-kara siroi neko-ga haitte-ki-ta]-**no**]-ga
kitchen-GEN window-from white cat-NOM came-in-PAST-**no**]-NOM
kesa mata yattekita.
this-morning again came
[*[The cat such that…]* a white cat came in from the window]
came back this morning.

b. ✓[Daidokoro-no mado-kara siroi neko-ga haitte-ki-ta]-**no**]-ga
kitchen-GEN window-from white cat-NOM came-in-PAST-**no**]-NOM
akana-o totte nigeta.
fish-ACC steal ran-away
[*[The cat such that…]* a white cat came in from the kitchen window]
stole a fish and ran away.

(43) $E_\pi = \lambda x.\textit{comein}(e) \wedge \textit{whitecat}(Ag(e)) \wedge \textit{throughthekitchen}(Path(e)) \wedge Time(e) < now$
The set of events of a white cat coming in through the window in the past

The internal head is *siroi neko*-'white cat', so we set the interpretation of P_π to the Ag role. From here on the derivation is just as in example (1), and we derive, on the condition that **k** is a Kuroda function, for the matrix:

(44) $\lambda e.\textit{come back}(e) \wedge \textit{this morning}(Time(e)) \wedge Ag(e) = \sigma(\lambda x.\exists e' \in E_\pi: Ag(e') = x \wedge \mathbf{k}(e') = e)$
The set of events of the cat that came in coming in today again

But, of course, we only derives this, if **k** is a Kuroda function, which means that there must be a natural salient sense in the context in which the event of the cat coming in in the past (before today) and the cat coming in today are regarded as a single process. But, as argued before, there is no such natural salient sense: the natural salient sense is to regard these entrance events as two, not as one. This means that E_{μ} is undefined, and the derivation stops. (2a) is infelicitous.

We have the same derivation for (2b) and derive, on the condition that **k** is a Kuroda function, for the matrix:

(45) λe. *stole a fish and ran away*(e) ∧ Ag(e) = σ(λx.∃e' ∈ E_{π}: Ag(e') = x ∧ **k**(e') = e)
The set of events of the cat that came in stealing a fish (then) and running away (after that)

I am skipping over the technicalities of connecting the coming-in event to the plural sum of a fish-stealing event and a running-away event. The point is: there is a *very natural* interpretation of these events as part of *one unrolling scenario*, hence in this case there *is* a salient Kuroda function, E_{μ} is defined, and after event existential closure we derive a felicitous interpretation along the lines of:

> Concerning the cat that came in through the window: there is a sequence of events continuing its coming in: namely, it stole a fish and then ran way.

4 Extending the analysis: Change relatives

We are now concerned with examples like (3a):

(3) a ✓John-wa [Mary-ga gozentyuu-ni *ringo-o* sibottekureta-**no**]-o
John-TOP [Mary-NOM morning-in *apple*-ACC squeezed-**no**]-ACC
gogo-ni hitoikide nomihosita.
afternoon-in in-a-gulp drank-up
John drank in the afternoon in a gulp *[the juice such that …]*
Mary squeezed apples in the morning.

As we have seen, (3a) is felicitous, even though the interpretation head (*apple juice*) is not the same as the interpretation of the internal head (*apples*). Similar examples are the felicitous (46a) and (46b):

(46) a. ✓John-wa [[[mizu-ga hiruma-ni kootta]-**no**]-no ue]-de
John-TOP water-NOM day-during frozen-**no**-GEN surface-on
moosudeni yuugata-ni sukeeto-o sita.
already evening-in skate-ACC did
John skated in the evening already on *[the ice such that]*
the water froze during the day.

b. ✓Mary-wa [[[koori-ga hiruma-ni toketa]-**no**]-no naka]-de
Mary-TOP ice-NOM day-during melted-**no**-GEN inside-in
moosudeni yuugata-ni oyoida.
already evening-in swam
Mary swam in the evening already in *[the water such that]*
the ice melted during the day.

It is instructive to compare the felicitous example (3) with the infelicitous (47):

(47) #John-wa [Mary-ga gozen hachi-ji-ni fuudopurosessaa-ni
John-TOP Mary-NOM morning 8-o'clock-DAT foodprocessor-DAT
kakeru-tame-ni
put-into-purpose-DAT
ringo-o kirikizanda-**no**]-o gogo-ni hitoikide nomihosita.
apple-ACC cut-into-pieces-**no**-ACC afternoon-in in-a-gulp drank-up
John drank in the afternoon in a gulp *[the juice such that …]*
Mary cut *apples* into pieces for the foodprocessor at eight in the morning.

It is hard to construct a similar contrast for the examples in (46), because it is hard to find examples that naturally satisfy Kuroda relevancy. This is not a problem in (47): arguably, (47) satisfies Kuroda relevancy in the same way as (3), so failure to satisfy Kuroda relevancy is not the source of the infelicity in (47).

Internally headed relatives like the above examples were first discussed in Hoshi (1995) and came to be called *change* relatives in the literature. While the actual examples discussed here are structurally ambiguous between an analysis as internally headed relatives and an analysis involving a bi-clausal adverbial construction, it is argued in Grosu & Hoshi (2016) that such cases can be disambiguated, and examples of internally headed *change* relatives, which do not allow an analysis involving a bi-clausal adverbial construction, do indeed exist. The analysis presented in this section, then, applies to cases like (3) and (46) on their analysis as internally headed *change* relatives.

What is the difference between the felicitous example in (3) and the infelicitous example in (47)? Let's first see what the similarity is. Both in (3) and in (47), E_π is a set of events where the internal head is a sum of count objects and the presumed interpretation head is a liquid that this sum of objects is turned into via *a transition procedure* (squeezing). The main difference between the felicitous example in (3) and the infelicitous example in (47) seems to be that in (3) the transformation is *entailed* by the semantics of E_π, whereas in the examples in (47), it is not entailed by the semantics of E_π, but pragmatically induced. Thus in (3) the events in the event type are themselves events of turning the theme into liquid, while the events in (47) are not. The generalization then is:

Internally headed change relatives:
In internally headed change relatives, where E_π *expresses semantically* a transformation of π, the interpretation head can be taken to be the result of the transformation.

What we see, then, is that in contrast to non-change internally headed relatives, in *change* relatives the relation between the interpretation of π and the interpretation head can be more relaxed.[17]

As we observed, change-relatives are only possible if in XP_π the verb *expresses* a phase-transformation on the role R_π. Let us call this a change-event type (on role R_π):

[17] Two caveats. In the first place, it is useful to note that the change analysis developed in this section is an interpretation strategy *besides* the strategy with normal Kuroda functions already discussed in Section 3. That is, the present strategy doesn't replace the latter strategy, it adds another interpretation possibility. Secondly, to keep the exposition simple, I suppress reference to the world-time parameter in the semantics, which, arguably is a bit silly when change is involved, but I trust that the specialists can provide the relevant semantic details themselves.

Change-event type:
E is a *change-event type on role* R iff for every e ∈ E: e is an event of performing a phase-transformation on R(e).

What we will do now is use the mechanism of Kuroda functions already introduced also to give the semantics for change-relatives. We are going to define the notion of a *change function*, and will require the Kuroda function in change-interpretations also to be a change function.

Clearly then, a change function **k** is going to be a function from change event type E_π on role R_π into event type E_μ. The first idea about change function **k** is that it associates with role R_π on E_π a role $R_{\pi,\mathbf{k}}$ on E_μ. What is the relation between R_π and $R_{\pi,\mathbf{k}}$? That is the second idea about **k**. For event $e \in E_\pi$, $R_\pi(e)$ is the thing that e performs the transformation on. $R_{\pi,\mathbf{k}}(\mathbf{k}(e))$ is the stuff that e transforms $R_\pi(e)$ into. In a definition:

Change function:
A *change function* is a function $\mathbf{k}_R$: $E_1 \rightarrow E_2$ (written for readability as **k**) such that:
1. E_1 is a change-event type on role R.
2. **tr**[e,R(e)] is the stuff that results from e performing the phase transformation on R(e).
3. $R_{\pi,\mathbf{k}}$ is a role in E_2 such that $R_{\pi,\mathbf{k}}(\mathbf{k}(e)) = \mathbf{tr}[e,R(e)]$.

We are going to assume a change function **k**: $E_\pi \rightarrow E_\mu$ relative to role R_π. Above in Section 3 we gave the following interpretation to PP_π:

$$PP_\pi \rightarrow \lambda e.R_\pi(e) = x_n \wedge \mathbf{k}(e) = e_\mu$$

For the change interpretation, we replace this by:

Change interpretation:
$$PP_\pi \rightarrow \lambda e.R_{\pi,\mathbf{k}}(\mathbf{k}(e)) = x_n \wedge \mathbf{k}(e) = e_\mu$$

So, in the standard interpretation, variable x_n links via role R_n to E_π, with the effect that the relative denotes what fills role R_n in the events in E_π. In the change interpretation, variable x_n links, via role $R_{\pi,\mathbf{k}}$, to the range $\mathbf{k}(E_\pi)$, i.e. $E_{\mu,}$ with the effect that the relative denotes the stuff *resulting from* performing the phase transformation to what fills role R_n in the events in E_π.

Note that by using the change Kuroda function to bring in **tr**[e,R(e)], the result stuff, we are avoiding the need to postulate a role in the event type E_π which the result stuff fills.

We complete the analysis by specifying the relevant Lombardian presuppositions for change relatives.

Lombardian presuppositions:
Presupposition at E_π: **k** is a Kuroda function and a change function from change event type E_π on role R_π.
Presupposition at E_μ: **k** is a Kuroda function and a change function from E_π into E_μ.

This is the theory. We can now come back to the example:

(3) a ✓John-wa [Mary-ga gozentyuu-ni *ringo-o* sibottekureta-**no**]-o
John-TOP [Mary-NOM morning-in *apple*-ACC squeezed-**no**]-ACC
gogo-ni hitoikide nomihosita.
afternoon-in in-a-gulp drank-up
John drank in the afternoon in a gulp *[the juice such that …]*
Mary squeezed apples in the morning.

The internal head π is *ringo*-'apple', which here clearly has a count interpretation.

(48) $E_\pi = \lambda e.\ \textit{squeeze}(e) \wedge Ag(e) = Mary \wedge \textit{apples}(Th(e)) \wedge \textit{morning}(Time(e))$
The set of events of Mary squeezing apples in the morning
$R_\pi = Th$
E_π is a change event type on role Th.

$PP_\pi \rightarrow \lambda e.Th_{\mathbf{k}}(\mathbf{k}(e)) = x_n \wedge \mathbf{k}(e) = e_\mu$

We adjoin to E_π, do event existential closure, abstract over x_n and derive the definite interpretation of the relative:

(49) $\sigma(\lambda x.\exists e[\textit{squeeze}(e) \wedge Ag(e) = Mary \wedge \textit{apples}(Th(e)) \wedge \textit{morning}(Time(e)) \wedge Th_{\mathbf{k}}(\mathbf{k}(e)) = x \wedge \mathbf{k}(e) = e_\mu])$

We form the matrix event type E_μ on the presupposition that **k** is a Kuroda function and a change function from E_π into E_μ and apply event existential closure over the matrix event type and derive:

(50) $\exists e[\textit{drink}(e) \wedge Ag(e) = John \wedge \textit{in one gulp}(Manner(e)) \wedge \textit{afternoon}(Time(e)) \wedge Th(e) = \sigma(\lambda x.\exists e'[\textit{squeeze}(e') \wedge Ag(e') = Mary \wedge \textit{apples}(Th(e')) \wedge \textit{morning}(Time(e')) \wedge Th_{\mathbf{k}}(\mathbf{k}(e')) = x \wedge \mathbf{k}(e') = e])$
There is an event of John drinking in the afternoon in one gulp the stuff that *results* from what Mary did to apples in the morning in a squeezing transformation event.

The change presupposition is that the matrix event contains a role $Th_{\mathbf{k}}$ that maps the squeezing event e onto **tr**[e,Th(e)], the juice that results from event e of squeezing its theme. This presupposition is satisfied in the example by the natural assumption that $Th_{\mathbf{k}}$ is the theme role on the matrix, the role that the interpretation of the relative fills. With that, we derive the interpretation given under the formula above.

The Kuroda presupposition that the event of squeezing apples and the drinking the resulting apple juice in one gulp are in context naturally regarded as a single process is, we assume, naturally satisfied by **k**.

The idea, then, is that change relatives *use* the derivational mechanism that brings a Kuroda function into the interpretation: the Kuroda function **k** takes on a second role as a change function, which allows a liberalization *via* **k** of the relation between the interpretation of P_π and the ayay gap interpretation x_n in the interpretation of PP_π.

5 Conclusion and discussion

Unlike the operator-gap construction in externally headed relatives or antecedent-anaphor structure in discourse anaphora, internally headed relatives require for felicity a *relevancy relation* between the interpretation of the internal head inside the relative and the

interpretation of the matrix. The relevancy relation is interpreted as 'being contextually interpreted as part of a single process'. In the present analysis, this semantic connection is made via Kuroda-functions, functions mapping events onto events that are in context relevantly related in the right way.

The felicity requirement is implemented via a Lombardian presupposition mechanism which takes as input the event type that the internal head associates with, and links it to the matrix event type when that becomes available (on the conditions that such a link is possible, that is the felicity condition).

We have seen that the nature of the Kuroda-function-linking can be relaxed: while the internally headed relative expresses in the matrix properties of the object that fills the internal head role in the relevant internal head event type (or the sum of the objects that fill that role across that event type), internally headed relatives allows change-interpretations where the internally headed relative semantically expresses an event type of change with respect to one of its roles, and the matrix expresses properties not of the thing that fills that role, but of the stuff it gets changed into.

Any analysis of Japanese internally headed relatives will have to incorporate one way or another something that enforces the Kuroda constraint, but also allows for the required flexibility. I have presented a hybrid analysis: a standard operator-gap construction, with the gap the complement of a null preposition in PP_π, adjoined to XP_π. I have proposed that the semantics of the null preposition selects a role from the participant relation of XP_π, and I have argued that this forces the gap and the internal head to be syntactically local. I then showed how the event type and role analysis allows the notion of a Kuroda function to tie together in the semantic derivation the event type levels that are relevant for formulating the Kuroda constraint. For this we needed to develop a Lombardian presupposition mechanism, a mechanism where the input conditions and output conditions of the Kuroda function are expressed at different stages of the derivation. It was shown that the mechanism of Kuroda functions is flexible enough to incorporate the relaxations required for analyzing change relatives. Thus the sword cuts both ways: the hybrid analysis opens the way for implementing the Kuroda relevancy condition via Kuroda functions. The relative ease with which the latter extends to 'difficult' cases – like change relatives – provides support for the hybrid analysis, given that the analysis *does* need to account for island effects as well.

The Lombardian presupposition mechanism is, of course, an extension of classical presupposition mechanisms. We need such an extension because we are dealing with a doubly complex case.

In classical presupposition cases the actual presupposed information (like, say, a factive presupposition, deictic link, or a uniqueness condition) is usually not that complex; what is complex is the projection problem: determining the level of discourse information structure at which the presupposed information can be and/or must be assumed to be integrated. That question is just as relevant here, but I have not focused on it at all.

What is different in the present case is that the presupposed information is itself *relational* (or, as I have assumed, functional). Relational presuppositions are found in bi-clausal constructions, for instance, adverbial phrases that presuppose a certain temporal relation – like temporal overlap – between the time expressed in the adverbial and the time expressed in the main clause. This by itself is not necessarily very complex: in standard bi-clausal cases the semantics has two event types available at the same stage of derivation, and the actual presupposed relation can be readily expressed compositionally.

But, as the current paper argues, Japanese internally headed relatives are *not* bi-clausal structures. What internally headed relatives share with presuppositional bi-clausal

structures is that a relational presupposition is expressed between two event types. Where they differ is that there is no stage of the derivation (or, if you want, no grammatical level) at which these event types are simultaneously accessible. And the reason is precisely that Japanese internally headed relatives are true relatives and not bi-clausal structures. As true relatives, the two relevant event types correspond to syntactic trees one of which is embedded in the other, i.e. a hierarchical structure. This means that the contents of the relational presupposition is determined and constrained derivationally. This is what the Lombardian mechanism is about.

The Lombardian presupposition mechanism is tailored to the problem that we find in Japanese internally headed relatives: we have a construction whose semantics requires a relational connection between two events types, a connection that would be straightforward to formulate on a bi-clausal structure. But this semantics happens to sit on top of a structure that is arguably hierarchical. This way of formulating the problem suggests that we can regard the Lombardian presupposition mechanism as a mechanism making up for a *mismatch*, in the sense of Landman (2003), between the syntax and the semantics of the construction in question. I do not, at present, know of other cases, besides Japanese internally headed relatives, that must rely on a Lombardian presupposition mechanism in a similar way. But the present discussion suggests what to look for.

6 Appendix: scope in internally headed relatives

For completeness' sake, this appendix briefly discusses the two other salient properties of internally headed relatives that were mentioned in Section 1. Technical details of the analysis are given in Grosu & Landman (2012).

6.1 External scope and negation

Rodman (1976) argued that relative clauses are scope islands: quantificational and negative expressions do not take scope out of relative clauses. In event theories like the Davidsonian theory, it is generally assumed that negation and negative noun phrases must take scope over event existential closure.[18]

For internally headed relative clauses it has been observed that the internal head cannot be in the scope of negation: (23a) is infelicitous:

(51) a. #[*Hitorino insei-mo* doyoobi-no party-ni *ika-nakat-ta-no*]-ga
[*any grad-student* Saturday-GEN party-to *go*-NEG-PAST-**no**]-NOM
jitsuwa uchi-de peepaa-o kaite ita.
in-fact home-at paper-ACC writing was
[*[the students such that…] **no** graduate student(s)* came to the party on Saturday]
were in fact writing term papers at home.

In contrast to (51a), discourse anaphora, as in (51b), are felicitous:

(51) b. ✓*Hitorino insei-mo* doyoobi-no party-ni *ikanakatta*.
any grad-student Saturday-GEN party-to go-**NEG**-PAST
Karera-wa jitsuwa uchi-de peepaa-o kaite ita.
they-TOP in-fact home-at term paper-ACC writing was
No graduate student(s) came to the party on Saturday. They (i.e., the students) were in fact writing term papers at home.

Grosu & Landman (2012) suggest the following generalization:

[18] See e.g. the discussion in Landman (2000) of the proper formulation of existential closure and the levels where it takes place.

Scope blocking constraint:
The scope mechanism cannot give a scopal operation inside the internally headed relative scope over PP_{π}.

PP_{π} is attached to XP_{π} before event existential closure (when XP_{π} still has an event type interpretation). In event theories, the scope mechanism stores interpretations before event existential closure and retrieves these after event existential closure (cf. Landman 2000). With this, the above scope blocking constraint accounts for the infelicity of (51a): negation in (51a) must take scope over event existential closure, hence over PP_{π}. This violates the Scope blocking constraint.

Bhatt & Iatridou (2012) argue that negation is possible in internally headed relatives if the internal head takes scope over negation. Their example is (51c):[19]

(51) c. ✓[*nani-ka muzukashii hon-o* dono kyooju-mo yoma-nakat-ta-**no**]-o
[*what-ka difficult book*-ACC any professor read-not-PAST-**no**]-ACC
ano gakusee-wa yoni-deiru-rashii.
that student-TOP read-PROG-EVID
That student is apparently reading *[the book such that…]*
some difficult book ***no*** professor read.

Bhatt and Iatridou (2012) bring this example up as a problem for the analysis proposed in Grosu & Landman (2012) (and with that for the current analysis). However, any analysis of internally headed relatives in terms of event types must be embedded in a more general theory of scope and event types. Two observations are relevant here. First, the literature on aspect has long argued that negated accomplishments pattern with statives (e.g. Mittwoch 1988):

(52) a. #Fred ate three mangos *for a week*.
b. ✓Fred ate no mangos *for a week*.

Unlike (52a), (52b) is felicitous and it expresses the *complete absence* of mango eating during that week. The general assumption is that *for a week* modifies a state type, a set of states expressing one way or other the absence of mango-eating. This means that, though the negation applies after existential closure on the event type, a new state type is created that *for a week* applies to.[20]

In a similar spirit, Landman (2000) argues that the most natural reading of (53a) is cumulative between boys and girls, with *not a single movie star* scopally dependent (as in (53b)):

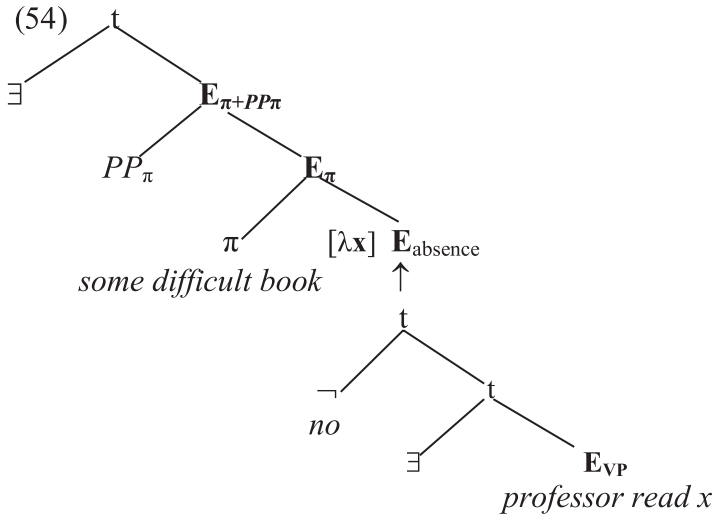
(53) a. Three boys introduced four girls to not a single movie star.
b. There are three boys and four girls and none of those boys introduced any of those girls to any movie star.

In the analysis of Landman (2000), cumulative readings are scopeless readings, where two arguments connect to different roles in one event type, here three boys as agent and four girls as theme. But the event type is a state type of x *refraining from introducing y to any movie star* (for technical details of the analysis, see Landman 2000).

We see that in both cases, the theory requires an operation that turns the negated proposition ¬φ into a an event type of *absence states* $E_{absence}$.

[19] Shimoyama p.c. to Bhatt & Iatridou, also cited in Erlewine & Gould (2012).
[20] Chris Tancredi suggests that what may be involved in these cases is an activity event type, rather than a set of states. For the present purposes the difference is not important.

Once we realize the need for an operation creating an event type of absence states, the obvious *semantic* structure of the internally headed relative in (51) becomes:



Thus, what happens semantically is that *in the scope of* PP_{π}, there are *two* semantically relevant event types: the lower one that is existentially closed before ¬ can apply, and the higher absence one that the internal head π relates to. This means that PP_{π} semantically adjoins to the higher of the two event types and, since Grosu & Landman's scope constraint is formulated semantically, it is not violated by this derivation: (51c) is correctly predicted to be felicitous.

Koji Hoshi p.c. points out that *nani-ka muzukashii hon*-'what difficult book' is functioning as a positive polarity item in examples like (51c), in particular, an item that does not want to be semantically interpreted in the scope of the negation. The felicity of (47c) depends on the interpretation of *nani-ka muzukashii hon* as taking scope over negation, not on its position: (51c) stays felicitous if we put *nani-ka muzukashii hon* in its non-scrambled position after the negative polarity item *dono kyooju*-'any professor'. This is quite compatible with the analysis presented here. The analysis *presupposes* a mechanism giving *nani-ka muzukashii hon* scope over negation. What the analysis *adds* is a mechanism constructing semantically an event type at the level where *nani-ka muzukashii hon* is interpreted. And this is the event type that PP_{π} adjoins to.

In a way, then, the assumption is that with the syntactic node XP_{π} a more extensive semantic interpretation strategy is associated (event existential closure – negation – event type opening – indefinite – PP_{π} adjunction). And the assumption is that this is a *local* mechanism in the sense that is relevant for the interpretation of PP_{π}.

6.2 Internal scope dependencies

We come back to Shimoyama's example (4a). (4a) allows an accumulation reading that corresponding externally headed relatives do not allow:

(4) a. Wasaburo-wa [dono gakusei-mo *peepaa-o* *3-bo* dasita-**no**]-o
Wasaburo-TOP [every student *paper*-ACC 3-CLF turned-in-**no**]-ACC
itiniti-de yonda.
one-day-in read
Wasaburo read in one day *[the papers such that…]*
every student turned in *three term papers*.
'Every student turned in three papers. Wasaburo read all the papers that all the students turned in in one day.'

The internal head *peepaa-o 3-bon*-'three term papers' is in the scope of a universal quantifier *dono gakusei-mo*-'every student'. In event theories, the universal quantifier takes scope over the event existential quantifier *(for each student x there is a set of events e_x of x turning in three term papers*). If we derive this with the scope mechanism, *dono gakusei-mo*-'every student' takes scope over E_π. There are two problems with this.

In the first place, this is incompatible with the scope blocking constraint**:** PP_π adjoins to the event type interpretation of XP_π and π is local in XP_π. But that means that PP_π adjoins *before* existential closure. This means that if we give the universal quantifier wide scope over the event existential quantifier, we necessarily give it wide scope over PP_π and we violate the scope blocking constraint.

In the second place, we don't want to think that this is a legitimate exception to the scope blocking constraint, because the reading derived by giving the universal quantifier wide scope with the scope mechanism is a reading that (4a) doesn't naturally have, and a reading which is not the natural one indicated above:

> Wasaburo read in one day three papers, *the same three papers* that every student turned in.

Grosu & Landman (2012) propose a different analysis for these cases. They argue, following Landman (2000), that cases like (55a) allow, besides the scopal analysis (55b), an analysis with a *dependency relation*, interpreted along the lines of (55c):

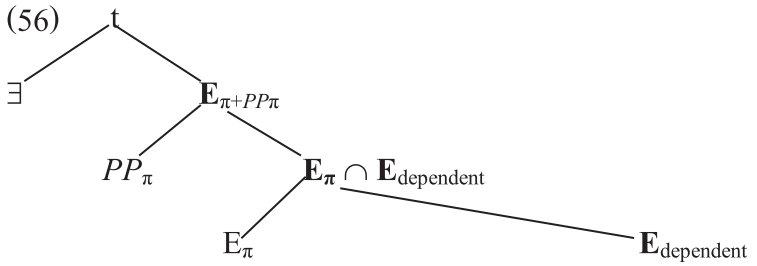
(55) a. [dono gakusei-mo *peepaa-o* *3-bon* dasita-**no**]-o.
[every student *term-paper*-ACC 3-CLF turned-in-**no**]-ACC
b. Every student turned in three term papers.
c. Students turned in term papers, *each student three term papers.*

The cumulative event type interpretation of *students turned in term papers* is called the Scha-event type in Landman (2000). Following Scha (1981), analyses of scopeless readings, cumulative readings, absorption readings, binary quantifier readings, dependency readings, etc. have generally involved something equivalent to the Scha-event type. The particular analysis in (55c) was inspired by the analysis of Moltmann (1992) of reciprocals and *same* and *different*.

In the analysis suggested in Landman (2000), the interpretation of *each student – three term papers* is an *event type adjoined* to the cumulative Scha event type. This adjoined event type is the set of all events such that the sum of its *sub*events with a *single* agent has as theme *a sum of three*. Intersected with the Scha event type, this gets the right interpretation for (55c) (for details of the semantics, see Landman 2000).

If we now assume that the internal head is *peepaa*-'papers', we see that the situation created in this derivation is similar to the one in the previous subsection: the analysis involves *two event types*, the dependent event type which contains the scopal element *each* and the cumulative event type to which the latter is adjoined:

(56)



students turned in papers *each one of these* (students) – *three of these* (papers)

The internal head of the relative is, on this analysis, *not* in the event type which is in the scope of the quantifier (per student, the set of subevents of that student turning-in the papers (s)he turned-in), *but* in the higher cumulative event type: *papers* in the set of events of students turning in papers, as restricted by the adjunct. This means that, once again, the scope constraint is not violated and this is a felicitous derivation for (4a).

The rest of the derivation is just a question of technical diligence. The reading derived for the relative clause in (4a) is the correct one:

> The sum of all term papers turned in by students, where every student turned in three term papers

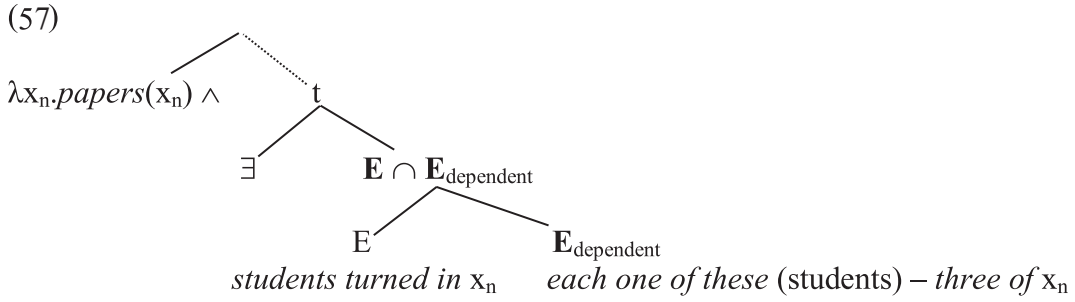
This analysis, then, solves both problems: the analysis does not violate the scope blocking constraint and it derives the correct interpretation for (4a). The Scha event type is cumulative, and the internal head connects to its theme role. Hence, the internally headed relative accumulates the themes of all the events in the Scha event type, i.e. all papers written. This means that the analysis derives the correct reading for (4a). The reading is, in fact, support for the scopal analysis, because the correct reading derives from the fact that the higher event type is in essence the cumulative Scha event type.

We come briefly back to the issue mentioning in Section 1, footnote 4. Chris Tancredi points out that an accumulation reading is also possible for externally headed examples like (i) (from footnote 4), where the numerical *3-bon*-3-CLF is inside the relative and the head is *peepaa-*'paper':

(i) Wasaburo-wa [[dono gakusei-mo 3-bon dasi-ta] peepaa]-o itiniti-de yon-da.
Wasaburo-TOP every student 3-CLF turned-in] paper]-ACC one-day-in read
'Wasaburo read the sum of all term papers turned in by students, where every student turned in three term papers.'

To derive this reading we only need to assume that the IP inside the relative allows for the *same* semantic analysis with a Scha event type and dependency relation as the IP as in (4a) above, but, of course, without an internal head: i.e. with variable x_n corresponding to the gap of the external relative, which is abstracted over at the CP-level and constrained there by the external head *peepaa-*'paper':

(57)



The definite interpretation of this will derive the same accumulation reading.

Coming back to internally headed relatives, note that similar cumulative examples exist for change relatives:

(58) ✓Watasi-wa [[kodomotati-ga meimei kesa *ni-ko-no* *orenzi-o*
I-TOP children-NOM each this-morning 2-CLF-GEN *orange*-ACC
sibottekureta]-**no**]-o gogo-ni nonda.
squeeze-PAST-**no**-ACC afternoon-in drink-PAST
I drank in the afternoon *[the juice such that]*
each of the children squeezed *two oranges* this morning.
'Each of the children squeezed two oranges this morning. In the afternoon I drank the juice resulting from all those orange-squeezings.'

Here too we assume that E_π is the higher event type, and we assume that strictly speaking it is *orenzi*-'oranges' which is the internal head, because it is the interpretation of *orenzi*-'oranges' which is entered in the higher event type, and not *ni-ko-no orenzi*-'two oranges'. The relevant event type E_π is the cumulative event type in which all the oranges are accumulated as the theme. So it is the cumulative event type which is the change event type, and it is its cumulative theme which is transformed into the theme of the matrix event type.

In sum, I propose here to analyze cumulative internally headed relatives like (4a) and (58) with an internal scope mechanism and a dependency relation. As study of the history of the semantics of plurality amply shows, the mechanisms in question are not *ad hoc* semantic tricks invented for the occasion, but are techniques that have been argued to be fruitful and useful in many other semantic contexts.

Turning the wheel full circle, we can take scopal relations inside Japanese internally headed relatives as independent evidence for fruitfulness and usefulness of internal scope mechanisms and dependency relations.

Abbreviations

NOM = nominative; ACC = accusative; DAT = dative; GEN = genitive; LOC = locative; TOP = topic; EVID = evidential; AUX = auxiliary; COP = copula; CLF = classifier; NEG = negation; PAST = past tense; PROG = progressive

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Competing interests

The author declares that he has no competing interests.

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